# Neoplasia (Tumors)

### *I. Causative Agent and Disease*

Cancers or neoplasms are growths of abnormal cells that proliferate uncontrollably. In bivalve molluscs, neoplasms are rare in comparison to vertebrates but more common than in other invertebrate phyla. Neoplastic lesions have been reported most commonly in oysters but also in other marine clams and mussels including mesenchymal tumors, epithelioma, myofibroma, germinoma, neurofibroma, sarcomas and disseminated neoplasia resembling leukemia. Bivalve molluscs develop cancer in much the same way as do higher animals. Known and suspected factors contributing to neoplasia in molluscs include viruses, environmental chemicals (carcinogens), repeated physical trauma, hormones, age, sex and genetic predisposition.

### *II. Host Species*

Neoplasia has been reported in: Pacific and Olympic (native) oysters on the Pacific coast of North America as well as the eastern oyster on the Gulf and Atlantic coasts; ocean quahog, hard and soft-shell clams and bay scallop on the Atlantic coast; Pacific oyster and mussel in Japan; pearl oyster in Australia; Chilean oyster in Chile and New Zealand; the European flat oyster in Spain and Yugoslavia; the common cockle in Ireland and Spain; the Mediterranean mussel in Spain; the blue mussel in Great Britain, Scandinavia, Tasmania and North America including British Columbia, Canada. Disseminated neoplasia is reported to occur in at least 15 marine bivalve species from four continents and every ocean except the Antarctic. In Alaska, neoplasms observed in bivalve molluscs have included germinoma (gonadal origin) in an adult Pacific oyster, mesenchymal (connective tissue origin) tumor in a blue mussel, disseminated neoplasia (hemocyte origin) in a blue mussel and littleneck clam and a secretory cell adenoma of the gill arch in a geoduck clam.

### *III. Clinical Signs*

Clinical signs of neoplasia may include a grossly visible abnormal tissue mass but more commonly neoplasia in bivalve molluscs is an incidental finding during routine histological examination. High prevalences of disseminated or hemic neoplasia in blue mussels and soft shell clams have been associated with significant mortality of 30-80%.

### *IV. Transmission*

Most neoplasms described in bivalve molluscs are considered spontaneous resulting from environmental contamination, congenital malformation, age or genetic predisposition and are not transmissible in nature. A major exception is disseminated neoplasia in clams, mussels and cockles which has been transmitted in mussels by cohabitation and in mussels and cockles by injection of cancerous cell-free tissue homogenates suggesting an infectious agent. In soft-shell clams mixed results using cell-free homogenates are reported but a retrovirus is suspected to cause the disease in all three bivalve species. The highest prevalences of disseminated neoplasia occur during autumn and winter months with highest bivalve mortality occurring in late winter and early spring.

### *V. Diagnosis*

Neoplasms are diagnosed and classified using histological methods to determine the cell or tissue of origin and

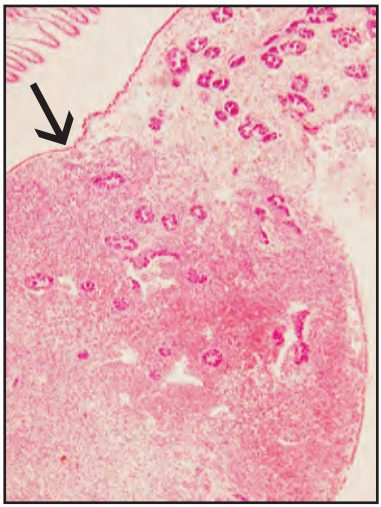
are further grouped based on benign or malignant characteristics. Benign tumors are often well-differentiated, grow slowly, are well circumscribed without invading surrounding normal tissue and do not metastasize. Most benign neoplasms usually end in the suffix "oma". Exceptions are benign neoplasms of the brain and some endocrine organs in higher vertebrates that can be life threatening due to their location and deleterious physiological effects on the host. Malignant tumors are often not well differentiated, may grow rapidly, infiltrate normal tissues and tend to metastasize. The names of these neoplasms are often preceded by the word "malignant" or with the suffixes "sarcoma" or "carcinoma". Disseminated neoplasia in bivalve molluscs is characterized by intense infiltration of tissues by abnormal hemocytes that have very little cytoplasm and enlarged pleomorphic nuclei with frequent mitotic figures. The neoplastic cells can be examined from wet and stained preparations of collected hemolymph and during histological examination of cut tissue sections.

### *VI. Prognosis for Host*

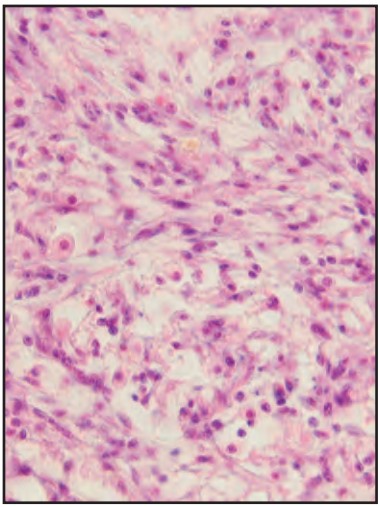
Neoplasia usually results in death of the affected bivalve mollusc, although remission has been known to occur with disseminated neoplasia. High prevalences of disseminated neoplasia are associated with high mortality of bivalve mollusc populations, especially those that have been previously unexposed. Due to the transmissible nature of this cancer, known infected stocks of bivalve molluscs should not be introduced to new areas.

### *VII. Human Health Significance*

Although aesthetically disturbing, there are no zoonotic human health concerns associated with neoplasia in bivalve molluscs. Except for disseminated neoplasia that has a suspected viral etiology, cancer is generally a rare event in bivalve molluscs affecting one animal in several thousand. Should these other tumors occur more frequently in a population, an indirect human health concern would be whether the cause is linked to environmental contamination.



Histological section of mesenchymal neoplasm (arrow) in blue mussel



Higher magnification of fibroblastic type cells composing the mesenchymal neoplasm

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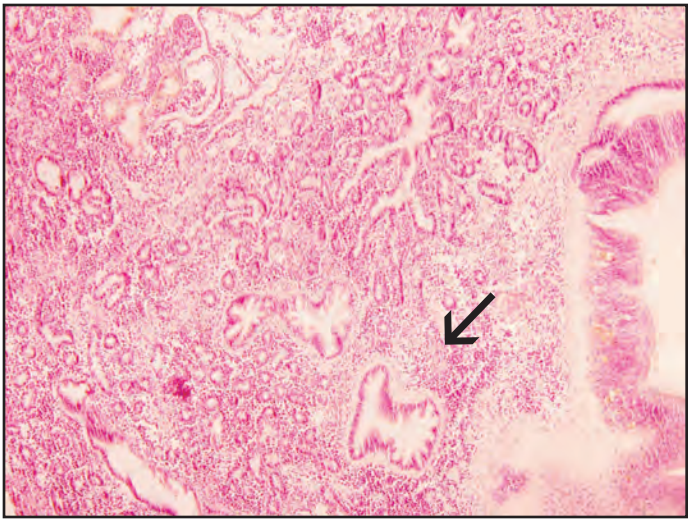
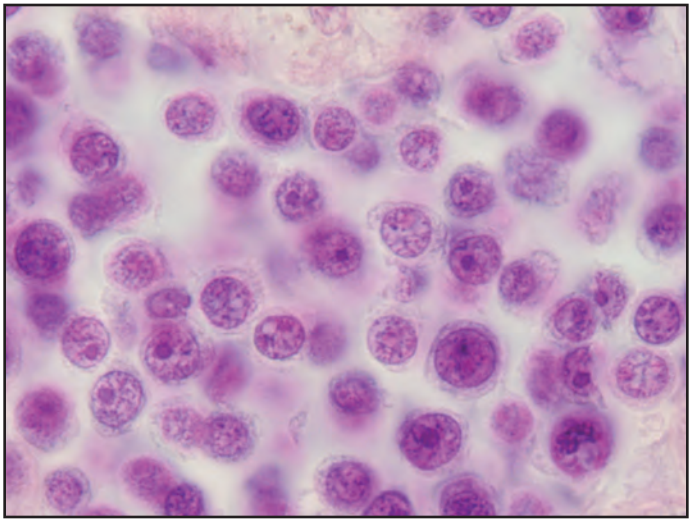
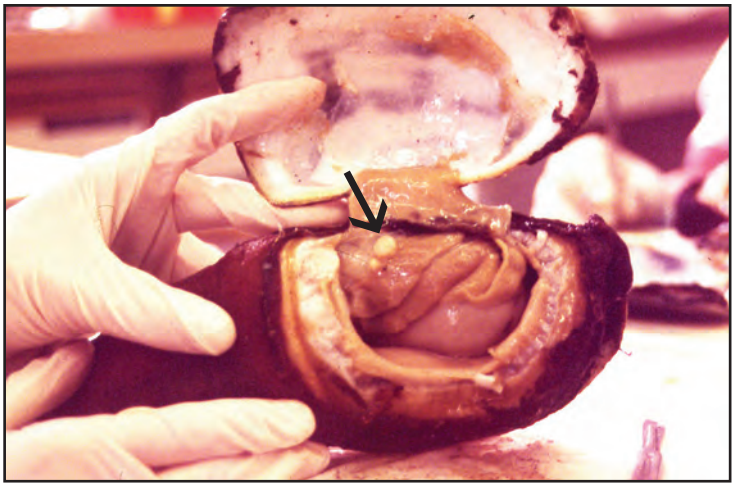


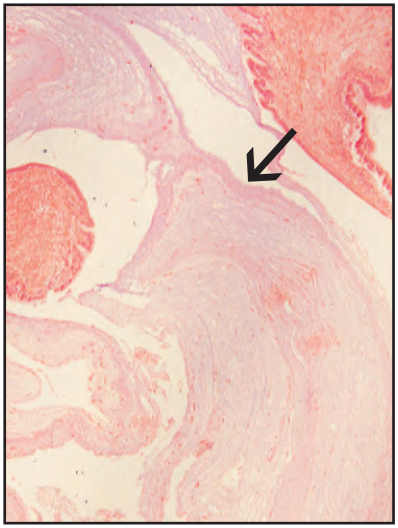
Histological section of disseminated neoplasia (arrow) in blue mussel



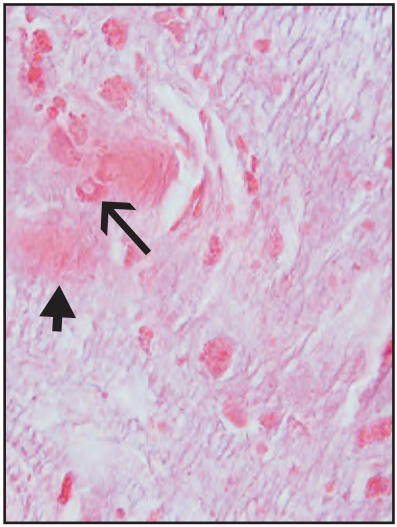
Higher magnification of typical leukemic-like cells with large nuclei and scant cytoplasm comprising disseminated neoplasia



Two white nodular foci (arrow) of a secretory cell adenoma on the gill arch of a geoduck clam



Histological section of geoduck adenoma composed of concentric whorled layers of basophilic mucinous material (arrow) containing secretory type cells and areas of collagen



Higher magnification of collagen (arrowhead) and secretory-type cells (arrow) containing eosinophilic droplets also found free in the tumor mass